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(19)

(54) DIE FOR USE IN SECURING A DEFORMABLE ELEMENT TO A SHEET

(71) We, AVDEL LIMITED, a British Company, of Mundells, Welwyn Garden City, Hertfordshire, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a die for use in securing to a sheet (e.g. of metal) a deformable element (such as a pierce-nut). In use, the sheet is positioned adjacent the die and the element is forced into the sheet so that part of it enters the die. The die is so shaped and arranged that it deforms portions of the element into engagement with the sheet, thus securing the element to the sheet.

One example of such a die and of a method of using it to secure a pierce-nut in a metal sheet is disclosed in British patent specification No. 1,346,640. A system embodying this nut and method is commercially available in the United Kingdom under the Trade Mark "SYSTEM M-F".

In practice, it is found that, after the deforming operation is complete, the deformed nut tends to cling to the die. The force required to remove or strip the placed nut from the die can be considerable and is found to increase with die life. The present invention seeks to reduce the stripping force required.

The present invention provides a die for use in securing to a sheet a deformable element, in use of which the sheet is positioned adjacent the die and the element is forced into the sheet from the side thereof remote from the die so that part of the element enters the die and portions of the element are defomed by the die into engagement with the sheet thus securing the element to the sheet;

which die comprises a plurality of parts which are relatively movable after completion of a deforming operation to facilitate removal of the deformed element from the die.

The invention also provides a die for use in securing to a metal sheet a metal element, in use of which the metal sheet is positioned adjacent the die and the element is forced into the sheet from the side thereof remote from the die so that part of the element enters the die and portions of the element are deformed by the die into engagement with the sheet thus securing the element to the sheet;

which die comprises a plurality of parts which are relatively movable after completion of a deforming operation to facilitate removal of the deformed element from the die.

In a preferred embodiment of the invention, the die includes a housing having a socket which receives the movable parts of the die. The socket may be tapered and the movable parts of the die then have correspondingly tapered faces which seat in the tapered socket. The exterior of the movable parts of the die may have circular symmetry, in which case the die includes means to prevent rotation of the movable parts in the housing. In a preferred embodiment, the means to prevent rotation comprises a recess in each movable part and a plurality of corresponding projections on the socket. Preferably each recess is provided by a groove or keyway in a movable part and each corresponding projection is provided by a pin or key. The die may include means for resiliently urging the relatively movable parts towards each other thereby to close the parts together after removal of the deformed element.

In a preferred embodiment of the invention, there are two such relatively movable parts.

A specific embodiment of the invention will now be described by way of example and with reference to the accompanying drawings, in which:

Figure 1 is a plan view of a die, and

Figure 2 is a vertical axial section through the die on the line II—II of Figure 1.

The die 12 of this example comprises a housing block 11 and two relatively movable

parts 13, 14 which meet along a central axial plane 15. When the two die-parts 13, 14 are together in contact (as shown in the accompanying drawings) the upper end of the die prsents a continuous cutting edge 16 surrounding an aperture 17. The aperture has the shape of a square with an arcuate intrusion at each corner as shown in Figure 1. Each arcuate intrusion is provided by a part-spherical pocket 18. In use, a metal sheet is positioned in contact with the top of the die, and a pierce-nut having a pilot-portion of square section equal in size to the square configuration of cutting edge 16 but complete to the corners with no arcuate intrusions, is forced downwards into the sheet above the die, so that the pilot portion punches through the sheet and enters the die aperture. The four pockets 18 gouge out the corners of the pilot portion which are deformed and compressed in the pockets into tight engagement with the underside of the sheet. The pierce-nut also has flanges or other projections above the pilot portion which contact the topside of the sheet, so that the nut is held tightly in the sheet.

Thus far the operation of the die is similar to that described in British patent specification No. 1,346,640.

The die 12 of the present example differs from the prior art in comprising two relatively movable parts 13 & 14, as previously mentioned. The upper part of the peripheral exterior of the die parts is of frusto-conical form as indicated at 19 in Figure 2, and fits into a corresponding mating frusto-conical socket 21 in the housing 11. The lower part 20 of the peripheral exterior of the movable parts is cylindrical, the lower part of the socket being of complementary cylndrical form. Since the exterior of the die parts has circular symmetry, rotation of the die into the housing is prevented by two keys or pins 22 projecting into two grooves or keyways 23, one in each die part. When a pierce-nut is forced downwards through the sheet and into the die, the downward thrust on the die forces it hard into the frusto-conical socket, which thus pushes the die parts tightly together so that they behave as a solid die.

When the deforming operation is complete and the sheet with the pierce-nut secured in it is removed upwardly away from the die, any tendency for the nut to cling in the socket will pull the die upwards, out of its frusto-conical socket, thus enabling the die parts to move relatively apart from each other in a direction transverse to the die axis. This movement apart releases the frictional engagement between the nut and the die and allows the sheet to be freely removed. On the next operation of the die the descending sheet forces the die down again into its socket and bring the die parts together again.

A spring circlip 24 is fitted around the lower periphery of the movable die parts 13, 14, seated in a peripheral groove thereabout. The circlip resiliently urges the movable die parts towards each other. The result is that the die parts close together as soon as the deformed element has been removed from between their upper ends. This helps prevent the entry of swarf or other foreign matter between the flat abutting faces of the movable die parts, which would prevent the die parts from properly closing together and thus lead to a malfunction of the die since its transverse dimensions would be altered. The circlip also limits the extent to which the die parts 13, 14 can be removed from the housing, by abutting against a shoulder 26 inside the housing.

The improved die of the foregoing example allows substantial reduction of the stripping force required to remove the installed nut from the die.

The invention is not restricted to the details of the foregoing example. For instance, means may be provided for urging the die upwards independently of any pull exerted by removal of the panel. This may take the form of a spring which urges the die parts upwards but which is overcome by the downwards force of the nut on the die. Such a spring could be, for example, a coil spring acting between the bottom of the die 12 and the bottom of the housing 11. Alternatively the means for urging the die upwards may be provided by a mechanical lifter connected to the stripping device which lifts the panel off the die, so that the die is positively raised from its socket as the panel is lifted.

The configuration of the division of the die into a plurality of parts may take any convenient form which is found advantageous in particular circumstances.

Instead of being divided into two die-parts, the die may be divided into more than two parts, for example four parts, with the cleavage planes at right angles to each other and passing through the vertical axis of the die and through the mid-point of each side of the square die aperture. This configuration would allow each pocket to move radially outwards in the releasing operation, which might be advantageous since it is believed that the tendency of the nut to cling in the die is largely due to engagement of the deformed corners of the nut pilot in the die pockets.

WHAT WE CLAIM IS:—

1. A die for use in securing to a sheet a deformable element, in use of which the sheet is positioned adjacent the die and the

element is forced into the sheet from the side thereof remote from the die so that part of the element enters the die and portions of the element are deformed by the die into engagement with the sheet thus securing the element to the sheet;

which die comprises a plurality of parts which are relatively movable after completion of a deforming operation to facilitate removal of the deformed element from the die.

2. A die for use in securing to a metal sheet a metal element, in use of which the metal sheet is positioned adjacent the die and the element is forced into the sheet from the side thereof remote from the die so that part of the element enters the die and portions of the element are deformed by the die into engagement with the sheet thus securing the element to the sheet;

which die comprises a plurality of parts which are relatively movable after completion of a deforming operation to facilitate removal of the deformed element from the die.

3. A die as claimed in Claim 1 or Claim 2, which includes a housing having a socket which receives the movable parts of the die.

4. A die as claimed in Claim 3, in which the socket is tapered and the movable parts of the die have correspondingly tapered faces which seat in the tapered socket.

5. A die as claimed in Claim 3, in which the exterior of the movable parts of the die has circular symmetry, and the die includes means to prevent rotation of the movable parts in the housing.

6. A die as claimed in Claim 5, in which the means to prevent rotation comprises a recess in each movable part and a plurality of corresponding projections on the socket.

7. A die as claimed in Claim 6, in which each recess is provided by a groove or keyway in a movable part and each corresponding projection is provided by a pin or key.

8. A die as claimed in any of the preceding claims, including means for resiliently urging the relatively movable parts towards each other thereby to close the parts together after removal of the deformed element.

9. A die as claimed in any of the preceding claims, in which there are two relatively movable parts.

10. A die substantially as hereinbefore described with reference to, and illustrated in, the accompanying drawings.

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1 SHEET This drawing is a reproduction of the Original on a reduced scale

Fig. 1.

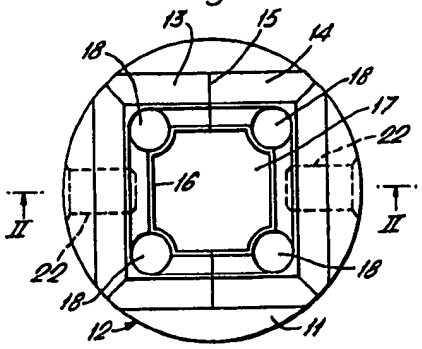

Fig. 2.